U.S. DEPARTMENT OF COMMERCE
National Technical Information Service
PB-286 293

Lake Minnehaha, Orange County, Florida

(U.S.) National Eutrophication Survey, Corvallis, OR

Prepared for

Corvallis Environmental Research Lab, OR

Dec 77

PB 286 293

U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON

and

ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

☆G.P.O. 899-460

REPORT

ON

LAKE MINNEHAHA

ORANGE COUNTY

FLORIDA

EPA REGION IV

WORKING PAPER No. 265

WITH THE COOPERATION OF THE

FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION

AND THE

FLORIDA NATIONAL GUARD

DECEMBER, 1977

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.

4. TITLE AND SUBTITLE
Report on Lake Minnehaha, Orange County, Florida

5. REPORT DATE
Prepared December 1977

6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)
Anonymous (National Eutrophication Survey Staff)

8. PERFORMING ORGANIZATION REPORT NO.
Working Paper # 265

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Pacific Northwest Environmental Research Laboratory
U.S. Environmental Protection Agency
200 S. W. 35th St.
Corvallis, Oregon 97330

10. PROGRAM ELEMENT NO.
1BA029

11. CONTRACT/GRANT NO.

12. SPONSORING AGENCY NAME AND ADDRESS
Office of Research and Development
U.S. Environmental Protection Agency
401 M Street, S. W.
Washington, DC 20460

13. TYPE OF REPORT AND PERIOD COVERED
Final - March 1973 - Feb. 1974

14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES
Prepared in cooperation with the U.S. Environmental Protection Agency, National Environmental Research Center, Las Vegas, Nevada 89114

16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
eutrophication lakes nutrients phosphorus nitrogen loading	National Eutrophication Survey Lake Survey	05B 05C

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(This Report)*	21. NO. OF PAGES
Release Unlimited	Unclassified	36
	20. SECURITY CLASS *(This page)*	22. PRICE
		A03-A01

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Florida Department of Environmental Regulation for professional involvement and to the Florida National Guard for conducting the tributary sampling phase of the Survey.

Joseph W. Landers, Jr., Secretary of the Department of Environmental Regulation; John A Redmond, former Director of the Division of Planning, Technical Assistance, and Grants; and Dr. Tim S. Stuart, Chief of the Bureau of Water Quality, provided invaluable lake documentation and counsel during the survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

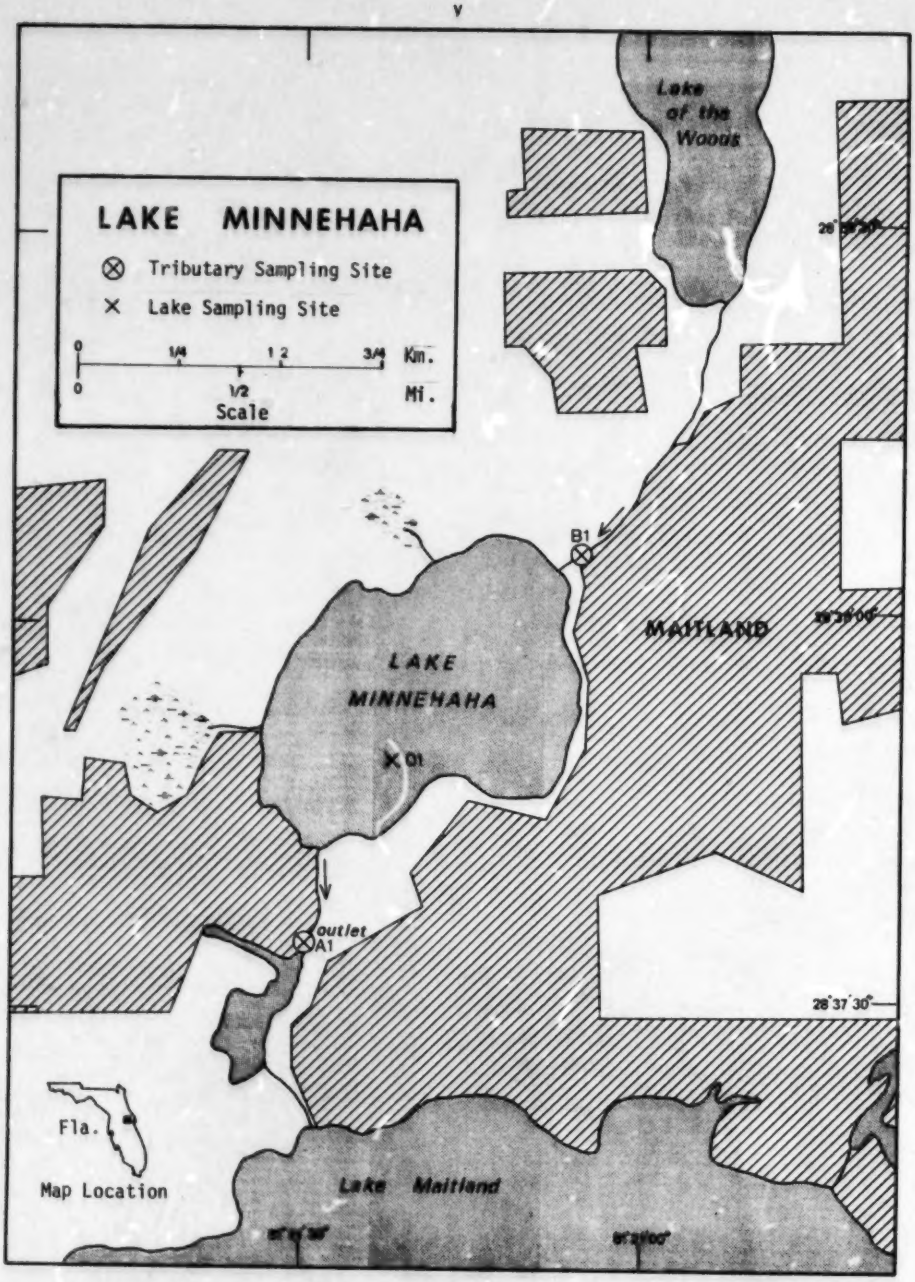
Major General Henry W. McMillan (Retired), then the Adjutant General of Florida, and Project Officer Colonel Hugo F. Windham, who directed the volunteer efforts of the Florida National Guard, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF FLORIDA

LAKE NAME	COUNTY
Alligator	Columbia
Apopka	Lake, Orange
Banana	Polk
Crescent	Flagler, Putnam
Doctors	Clay
Dora	Lake
East Tohopekaliga	Osceola
Effie	Polk
Eloise	Polk
George	Putnam, Volusia
Gibson	Polk
Glenada	Highlands
Griffin	Lake
Haines	Polk
Hancock	Polk
Horseshoe	Seminole
Howell	Orange, Seminole
Istokpoga	Highlands
Jessie	Polk
Jessup	Seminole
Kissimmee	Osceola
Lawne	Orange
Lulu	Polk
Marion	Polk
Minnehaha	Orange
Minneola	Lake
Monroe	Seminole, Volusia
Munson	Leon
Okeechobee	Glades, Hendry, Martin, Okeechobee, Palm Beach
Poinsett	Brevard, Orange, Osceola
Reedy	Polk
Seminole	Jackson, FL; Decatur, Seminole, GA
Seminole	Pinellas
South	Brevard
Talquin	Gadsden, Leon
Tarpon	Pinellas
Thonotosassa	Hillsborough
Tohopekaliga	Osceola
Trout	Lake
Weohyakapka	Polk
Yale	Lake


LAKE MINNEHAHA
Tributary Sampling Site
Lake Sampling Site
0 1/4 1/2 3/4 Km.
0 1/2 Mi.
Scale
Lake of the Woods
B1
MAITLAND
LAKE MINNEHAHA
01
outlet A1
28°37'30"
Fla.
Map Location
Lake Maitland

LAKE MINNEHAHA

STORET NO.1229

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Lake Minnehaha is mesotrophic. It ranked third in overall trophic quality when the 41 Florida lakes sampled in 1973 were compared using a combination of six parameters*. Five of the lakes had less median total phosphorus, eight had less median dissolved phosphorus, four had less and one had the same median inorganic nitrogen, six had less mean chlorophyll a, and only two had greater mean Secchi disc transparency.

Survey limnologists observed submerged and emergent macrophytes, and blue-green algae were prominent in all of the phytoplankton samples.

B. Rate-Limiting Nutrient:

There was a significant change in nutrient concentrations in the algal assay sample during shipment from the field to the laboratory, and the assay results are not representative of conditions in the lake at sampling time. The lake data indicate nitrogen limitation; i.e., the mean inorganic nitrogen to orthophosphorus ratios were 10 to 1 or less at all sampling times.

C. Nutrient Controllability:

1. Point sources--No known municipal or industrial point sources impacted Lake Minnehaha during the sampling year. Septic

* See Appendix A.

tanks serving lakeshore dwellings were estimated to have contributed about 6% of the total phosphorus and 14% of the total nitrogen inputs to the lake, but a shoreline survey would be necessary to determine the significance of those sources.

The sampling year phosphorus loading of 0.63 g/m^2 is only slightly less than that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading; and although Florida lakes may assimilate phosphorus at somewhat higher levels than those suggested by Vollenweider (see page 11), because of the increasing urbanization in the drainage area (see below), it is likely that Lake Minnehaha eventually will become eutrophic.

2. Non-point sources--The estimated non-point contributions accounted for essentially all of the phosphorus load during the sampling year, although the quantities of the inputs were relatively low.

The 1970 photorevised U.S.G.S. Casselberry quadrangle map shows a considerable increase in urban areas in the drainage in the eight years since the map originally was prepared. If urbanization continues as in the past, the eutrophic loading will be exceeded.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Morphometry††:

1. Surface area: 0.39 kilometers^2.
2. Mean depth: 3.0 meters.
3. Maximum depth: 4.0 meters.
4. Volume: 1.170×10^6 m^3.
5. Mean hydraulic retention time: 97 days.

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Unnamed Creek B-1	2.1	0.06
Minor tributaries & immediate drainage -	1.8	0.08
Totals	3.9	0.14

2. Outlet -

Unnamed Creek A-1	4.3**	0.14

C. Precipitation***:

1. Year of sampling: 123.5 centimeters.
2. Mean annual: 130.5 centimeters.

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† Table of metric conversions--Appendix B.
†† Wegner, 1967.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake.
*** See Working Paper No. 175.

III. WATER QUALITY SUMMARY

Lake Minnehaha was sampled three times in 1973 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from one or more depths at a single station on the lake (see map, page v). During each visit, a single depth-integrated (near bottom to surface) sample was collected for phytoplankton identification and enumeration, and a similar sample was taken for chlorophyll *a* analysis. During the first visit, a single 18.9-liter depth-integrated sample was taken for algal assays. The maximum depth sampled was 2.1 meters.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR LAKE MINNEHAHA
STORET CODE 1229

PARAMETER	1ST SAMPLING (3/14/73) 1 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (9/ 5/73) 1 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (11/ 5/73) 1 SITES RANGE	MEAN	MEDIAN
TEMP (C)	23.4 - 25.9	24.8	25.1	30.2 - 30.2	30.2	30.2	23.5 - 24.2	23.8	23.8
DISS OXY (MG/L)	7.3 - 9.1	8.2	8.2	7.8 - 7.8	7.8	7.8	8.8 - 8.8	8.8	8.8
CNDCTVY (MCROMO)	180. - 180.	180.	180.	192. - 192.	192.	192.	175. - 177.	176.	176.
PH (STAND UNITS)	8.3 - 9.0	8.7	8.9	8.0 - 8.0	8.0	8.0	7.4 - 7.7	7.5	7.5
TOT ALK (MG/L)	42. - 42.	42.	42.	39. - 39.	39.	39.	40. - 44.	42.	42.
TOT P (MG/L)	0.034 - 0.048	0.039	0.035	0.022 - 0.022	0.022	0.022	0.041 - 0.146	0.093	0.093
ORTHO P (MG/L)	0.006 - 0.012	0.008	0.006	0.013 - 0.013	0.013	0.013	0.025 - 0.117	0.071	0.071
NO2+NO3 (MG/L)	0.030 - 0.040	0.037	0.040	0.050 - 0.050	0.050	0.050	0.030 - 0.040	0.035	0.035
AMMONIA (MG/L)	0.030 - 0.050	0.040	0.040	0.050 - 0.050	0.050	0.050	0.040 - 0.040	0.040	0.040
KJEL N (MG/L)	0.500 - 0.700	0.567	0.500	1.200 - 1.200	1.200	1.200	0.500 - 0.600	0.550	0.550
INORG N (MG/L)	0.060 - 0.090	0.077	0.080	0.100 - 0.100	0.100	0.100	0.070 - 0.080	0.075	0.075
TOTAL N (MG/L)	0.530 - 0.740	0.603	0.540	1.250 - 1.250	1.250	1.250	0.530 - 0.640	0.585	0.585
CHLRPYL A (UG/L)	6.8 - 6.8	6.8	6.8	11.9 - 11.9	11.9	11.9	7.5 - 7.5	7.5	7.5
SECCHI (METERS)	2.5 - 2.5	2.5	2.5	1.4 - 1.4	1.4	1.4	1.0 - 1.0	1.0	1.0

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal units per ml
03/14/73	1. Raphidiopsis sp.	1,899
	2. Golenkinia sp.	669
	3. Kirchneriella sp.	524
	4. Tetraedron sp.	307
	5. Flagellates	271
	Other genera	1,285
	Total	4,955
09/05/73	1. Oscillatoria sp.	15,977
	2. Dactylococcopsis sp.	10,107
	3. Lyngbya sp.	1,251
	4. Tetraedron sp.	1,059
	5. Flagellates	866
	6. Scenedesmus sp.	673
	Other genera	3,851
	Total	33,784
11/05/73	1. Oscillatoria sp.	9,529
	2. Dactylococcopsis sp.	7,123
	3. Flagellates	1,925
	4. Kirchneriella sp.	1,251
	5. Chroococcus sp.	963
	6. Microcystis sp.	963
	Other genera	6,352
	Total	28,106

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
03/14/73	1	6.8
09/05/73	1	11.9
11/05/73	1	7.5

C. Limiting Nutrient Study:

There was a significant change in nutrient concentrations in the algal assay sample between the time of collection and the beginning of the assay, and the results are not representative of conditions in the lake at the time the sample was collected (03/14/73). The lake data indicate nitrogen limitation, i.e., the mean inorganic nitrogen to orthophosphorus ratios were 10 to 1 or less each sampling time.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Florida National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v). Sampling was begun in March, 1973, and was completed in February, 1974.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Florida District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the nutrient loads, in $kg/km^2/yr$, at station B-1 and multiplying by the ZZ area in km^2.

No known point sources impacted Lake Minnehaha during the Survey sampling year.

A. Waste Sources**:

1. Known municipal - None
2. Known industrial - None

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* See Working Paper No. 175.
** Stuart, 1976.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Unnamed Creek B-1	115	46.9
b. Minor tributaries & immediate drainage (non-point load) -	100	40.9
c. Known municipal STP's - None	-	-
d. Septic tanks* -	15	6.1
e. Known industrial - None	-	-
f. Direct precipitation** -	15	6.1
Total	245	100.0

2. Outputs -

Lake outlet - Unnamed Creek A-1 185

3. Net annual P accumulation - 60 kg.

* Estimate based on 51 lakeshore dwellings; see Working Paper No. 175.
** Brezonik and Shannon, 1971.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Unnamed Creek B-1	1,750	43.5
b. Minor tributaries & immediate drainage (non-point load) -	1,500	37.3
c. Known municipal STP's - None	-	-
d. Septic tanks* -	545	13.6
e. Known industrial - None	-	-
f. Direct precipitation** -	225	5.6
Total	4,020	100.0

2. Outputs -

Lake outlet - Unnamed Creek A-1 3,855

3. Net annual N accumulation - 165 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Unnamed Creek B-1	55	833

* Estimate based on 51 lakeshore dwellings; see Working Paper No. 175.
** Brezonik and Shannon, 1971.

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Note, however, that Florida lakes may be able to assimilate phosphorus at a somewhat higher level than that suggested by Vollenweider (Shannon and Brezonik, 1972).

Essentially, Vollenweider's "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	0.63	0.15	10.3	0.4

Vollenweider phosphorus loadings ($g/m^2/yr$) based on estimated mean depth and hydraulic retention time of Lake Minnehaha:	
"Dangerous" (eutrophic loading)	0.64
"Permissible" (oligotrophic loading)	0.32

V. LITERATURE REVIEWED

Brezonik, Patrick L., and Earl E. Shannon, 1971. Trophic state of lakes in north central Florida. Publ. No. 13, FL Water Resources Res. Ctr., U. of FL, Gainesville.

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Wegner, William, 1967. Clermont chain of lakes. Central Florida Region Fish Management Area. Progress report submitted to the Florida Game & Fresh Water Fish Commission, Tallahassee.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
1201	ALLIGATOR LAKE	0.620	0.260	474.000	87.733	13.100	0.386
1202	LAKE APOPKA	0.102	0.230	484.176	46.611	8.200	0.019
1203	LAKE BANANA	0.660	0.260	482.667	208.600	3.600	0.293
1206	LAKE CRESCENT	0.065	0.130	473.889	10.211	10.200	0.033
1207	DOCTORS LAKE	0.084	0.120	465.555	27.100	10.600	0.028
1208	LAKE DORA	0.102	0.240	482.889	59.978	7.400	0.022
1209	LAKE EFFIE	1.480	0.410	489.000	261.433	15.000	0.950
1210	LAKE GEORGE	0.129	0.165	469.308	35.000	11.000	0.063
1211	LAKE GIBSON	0.167	0.115	470.000	19.675	10.200	0.069
1212	GLENADA LAKE	0.134	0.165	454.167	27.667	14.700	0.072
1214	LAKE GRIFFIN	0.119	0.260	481.333	66.855	6.600	0.038
1215	LAKE HAINES	0.063	0.115	462.667	26.567	10.600	0.014
1217	LAKE HANCOCK	0.772	0.195	483.500	97.900	5.600	0.158
1219	LAKE HORSESHOE	0.034	0.130	459.000	12.067	11.500	0.023
1220	LAKE HOWELL	1.260	0.285	464.000	54.117	9.000	1.175
1221	LAKE ISTOKPOGA	0.039	0.120	464.222	6.594	8.600	0.010
1223	LAKE JESSUP	0.492	0.290	487.000	76.550	7.600	0.288
1224	LAKE KISSIMMEE	0.034	0.145	463.667	24.142	8.800	0.007
1227	LAKE LULU	1.490	1.065	483.000	276.566	14.300	1.030
1228	LAKE MARION	0.044	0.260	468.833	29.967	7.600	0.016
1229	LAKE MINNEHAHA	0.038	0.080	435.000	8.733	7.700	0.012
1230	LAKE MINNEOLA	0.018	0.070	406.333	3.333	7.400	0.009
1231	LAKE MONROE	0.188	0.300	474.555	14.225	10.800	0.128
1232	LAKE OKEECHOBEE	0.063	0.185	472.366	14.524	9.800	0.010
1234	LAKE POINSETT	0.085	0.150	469.000	6.500	10.600	0.051
1236	LAKE REEDY	0.033	0.330	468.500	34.837	10.600	0.008
1238	LAKE SOUTH	0.074	0.130	464.000	23.167	9.000	0.028
1239	LAKE TALQUIN	0.085	0.290	462.167	9.483	14.480	0.031

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
1240	LAKE THONOTOSASSA	0.695	0.095	466.167	37.700	10.200	0.565
1241	LAKE TOHOPEKALIGA	0.246	0.200	472.917	30.633	10.500	0.152
1242	TROUT LAKE	1.110	0.650	472.000	76.967	12.900	0.970
1243	LAKE WEOHYAKAPKA	0.047	0.080	458.667	7.767	8.200	0.011
1246	LAKE YALE	0.027	0.160	441.000	25.367	7.600	0.014
1247	LAKE MUNSON	1.475	0.925	486.667	140.317	12.200	0.852
1248	LAKE SEMINOLE	0.234	0.175	473.833	102.000	8.600	0.026
1249	LAKE LAWNE	2.560	1.350	494.667	84.900	10.400	0.117
1250	LAKE TARPON	0.041	0.070	400.889	6.867	9.000	0.027
1252	LAKE ELOISE	0.486	0.170	465.333	70.233	12.200	0.339
1258	LAKE JESSIE	0.051	0.090	452.667	26.300	10.800	0.011
1261	EAST LAKE TOHOPEKALIGA	0.042	0.070	440.833	5.167	9.400	0.007
1264	PAYNE'S PRAIRIE LAKE (NO	1.260	0.140	476.000	88.200	7.400	1.210

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
1201	ALLIGATOR LAKE	25 (10)	29 (10)	30 (12)	18 (7)	10 (4)	18 (7)	130
1202	LAKE APOPKA	50 (20)	38 (15)	10 (4)	38 (15)	74 (29)	70 (28)	280
1203	LAKE BANANA	23 (9)	29 (10)	20 (8)	5 (2)	100 (40)	23 (9)	200
1206	LAKE CRESCENT	65 (26)	70 (27)	33 (13)	80 (32)	48 (18)	50 (20)	346
1207	DOCTORS LAKE	60 (24)	76 (30)	60 (24)	55 (22)	34 (12)	56 (22)	341
1208	LAKE DORA	53 (21)	35 (14)	18 (7)	33 (13)	90 (35)	68 (27)	297
1209	LAKE EFFIE	5 (2)	10 (4)	3 (1)	3 (1)	0 (0)	10 (4)	31
1210	LAKE GEORGE	45 (18)	54 (21)	48 (19)	43 (17)	23 (9)	43 (17)	256
1211	LAKE GIBSON	40 (16)	81 (32)	45 (18)	70 (28)	48 (18)	40 (16)	324
1212	GLENADA LAKE	43 (17)	54 (21)	85 (34)	53 (21)	3 (1)	38 (15)	276
1214	LAKE GRIFFIN	48 (19)	29 (10)	23 (9)	30 (12)	95 (38)	48 (19)	273
1215	LAKE HAINES	70 (28)	81 (32)	75 (30)	58 (23)	34 (12)	78 (31)	396
1217	LAKE HANCOCK	18 (7)	43 (17)	13 (5)	13 (5)	98 (39)	28 (11)	213
1219	LAKE HORSESHOE	93 (37)	70 (27)	80 (32)	78 (31)	20 (8)	65 (26)	406
1220	LAKE HOWELL	11 (4)	23 (9)	69 (27)	35 (14)	60 (23)	3 (1)	201
1221	LAKE ISTOKPOGA	85 (34)	76 (30)	65 (26)	93 (37)	69 (27)	89 (35)	477
1223	LAKE JESSUP	28 (11)	18 (7)	5 (2)	25 (10)	83 (32)	25 (10)	184
1224	LAKE KISSIMMEE	90 (36)	63 (25)	73 (29)	65 (26)	65 (26)	99 (39)	455
1227	LAKE LULU	3 (1)	3 (1)	15 (6)	0 (0)	8 (3)	5 (2)	34
1228	LAKE MARION	78 (31)	29 (10)	53 (21)	50 (20)	83 (32)	73 (29)	366
1229	LAKE MINNEHAHA	88 (35)	91 (36)	95 (38)	85 (34)	78 (31)	80 (32)	517
1230	LAKE MINNEOLA	100 (40)	98 (38)	98 (39)	100 (40)	90 (35)	93 (37)	579
1231	LAKE MONROE	38 (15)	15 (6)	28 (11)	75 (30)	26 (10)	33 (13)	215
1232	LAKE OKEECHOBEE	68 (27)	45 (18)	40 (16)	73 (29)	53 (21)	89 (35)	368
1234	LAKE POINSETT	58 (23)	60 (24)	50 (20)	95 (38)	34 (12)	45 (18)	342
1236	LAKE REEDY	95 (38)	13 (5)	55 (22)	45 (18)	34 (12)	95 (38)	337
1238	LAKE SOUTH	63 (25)	70 (27)	69 (27)	68 (27)	60 (23)	56 (22)	386
1239	LAKE TALQUIN	55 (22)	20 (8)	78 (31)	83 (33)	5 (2)	53 (21)	294

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
1240	LAKE THONOTOSASSA	20 (8)	85 (34)	58 (23)	40 (16)	48 (18)	15 (6)	266
1241	LAKE TOHOPEKALIGA	33 (13)	40 (16)	38 (15)	48 (19)	40 (16)	30 (12)	229
1242	TROUT LAKE	15 (6)	8 (3)	43 (17)	23 (9)	13 (5)	8 (3)	110
1243	LAKE WEOHYAKAPKA	75 (30)	91 (36)	83 (33)	88 (35)	74 (29)	84 (33)	495
1246	LAKE YALE	98 (39)	58 (23)	90 (36)	63 (25)	83 (32)	75 (30)	467
1247	LAKE MUNSON	8 (3)	5 (2)	8 (3)	8 (3)	16 (6)	13 (5)	58
1248	LAKE SEMINOLE	35 (14)	48 (19)	35 (14)	10 (4)	69 (27)	63 (25)	260
1249	LAKE LAWNE	0 (0)	0 (0)	0 (0)	20 (8)	43 (17)	35 (14)	98
1250	LAKE TARPON	83 (33)	98 (38)	100 (40)	90 (36)	60 (23)	60 (24)	491
1252	LAKE ELOISE	30 (12)	50 (20)	63 (25)	28 (11)	16 (6)	20 (8)	207
1258	LAKE JESSIE	73 (29)	88 (35)	88 (35)	60 (24)	26 (10)	84 (33)	419
1261	EAST LAKE TOHOPEKALIGA	80 (32)	98 (38)	93 (37)	98 (39)	55 (22)	99 (39)	523
1264	PAYNE'S PRAIRIE LAKE (NO	11 (4)	65 (26)	25 (10)	15 (6)	90 (35)	0 (0)	206

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	1230	LAKE MINNEOLA	579
2	1261	EAST LAKE TOHOPEKALIGA	523
3	1229	LAKE MINNEHAHA	517
4	1243	LAKE WEOHYAKAPKA	495
5	1250	LAKE TARPON	491
6	1221	LAKE ISTOKPOGA	477
7	1246	LAKE YALE	467
8	1224	LAKE KISSIMMEE	455
9	1256	LAKE JESSIE	419
10	1219	LAKE HORSESHOE	406
11	1215	LAKE HAINES	396
12	1238	LAKE SOUTH	386
13	1232	LAKE OKEECHOBEE	368
14	1228	LAKE MARION	366
15	1206	LAKE CRESCENT	346
16	1234	LAKE POINSETT	342
17	1207	DOCTORS LAKE	341
18	1236	LAKE REEDY	337
19	1211	LAKE GIBSON	324
20	1208	LAKE DORA	297
21	1239	LAKE TALQUIN	294
22	1202	LAKE APOPKA	280
23	1212	GLENADA LAKE	276
24	1214	LAKE GRIFFIN	273
25	1240	LAKE THONOTOSASSA	266
26	1248	LAKE SEMINOLE	260
27	1210	LAKE GEORGE	256
28	1241	LAKE TOHOPEKALIGA	229

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
29	1231	LAKE MONROE	215
30	1217	LAKE HANCOCK	213
31	1252	LAKE ELOISE	207
32	1264	PAYNE'S PRAIRIE LAKE (NO	206
33	1220	LAKE HOWELL	201
34	1203	LAKE BANANA	200
35	1223	LAKE JESSUP	184
36	1201	ALLIGATOR LAKE	130
37	1242	TROUT LAKE	110
38	1249	LAKE LAWNE	98
39	1247	LAKE MUNSON	58
40	1227	LAKE LULU	34
41	1209	LAKE EFFIE	31

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 - cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR FLORIDA 8/25/75

LAKE CODE 1229 LAKE MINNEHAHA

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 4.3

NORMALIZED FLOWS(CMS)

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1229A1	4.3	0.13	0.14	0.20	0.07	0.03	0.09	0.17	0.26	0.33	0.18	0.08	0.06	0.14
122981	2.1	0.05	0.06	0.08	0.03	0.02	0.04	0.07	0.10	0.12	0.07	0.04	0.03	0.06
1229ZZ	3.9	0.07	0.09	0.12	0.03	0.01	0.05	0.11	0.15	0.21	0.10	0.04	0.03	0.08

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 4.3
SUM OF SUB-DRAINAGE AREAS = 6.0

TOTAL FLOW IN = 1.74
TOTAL FLOW OUT = 1.74

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
1229A1	3	73	0.12	17	0.05				
	4	73	0.05	7	0.05				
	5	73	0.02	13	0.02				
	6	73	0.05	17	0.03				
	7	73	0.25	7	0.05				
	8	73	0.41	4	0.66				
	9	73	1.38	8	0.89				
	10	73	0.22						
	11	73	0.04	3	0.04				
	12	73	0.04	8	0.04	15	0.03		
	1	74	0.05	12	0.05				
	2	74	0.08	15	0.04				
122981	3	73	0.05	17	0.03				
	4	73	0.03	7	0.03				
	5	73	0.02	13	0.02				
	6	73	0.03	17	0.02				
	7	73	0.09	7	0.03				
	8	73	0.15	4	0.23				
	9	73	0.47	8	0.31				
	10	73	0.08						
	11	73	0.02	3	0.03				
	12	73	0.02	8	0.02	15	0.02		
	1	74	0.03	12	0.03				
	2	74	0.04	15	0.03				
1229ZZ	3	73	0.07	17	0.02				
	4	73	0.02	7	0.02				
	5	73	0.00	13	0.00				
	6	73	0.02	17	0.01				
	7	73	0.15	7	0.02				
	8	73	0.26	4	0.43				
	9	73	0.91	8	0.58				
	10	73	0.13						
	11	73	0.01	3	0.02				
	12	73	0.01	8	0.01	15	0.01		
	1	74	0.02	12	0.02				
	2	74	0.04	15	0.02				

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/08/25

122901
28 37 54.0 081 21 20.0
LAKE MINNEHAHA
12095 FLORIDA

11EPALES
3

2111202
0013 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/03/14	16 00	0000	25.9		100	180	9.00	42	0.050	0.700	0.040	0.012
	16 00	0004	25.1	9.1		180	8.90	42	0.030	0.500	0.030	0.006
	16 00	0007	23.4	7.3		180	8.30	42	0.040	0.500	0.040	0.006
73/09/05	14 55	0000	30.2	7.8	55	192	8.00	39	0.050	1.200	0.050	0.013
73/11/05	12 45	0000	24.2		40	177	7.40	44	0.040	0.600	0.040	0.025
	12 45	0006	23.5	8.8		175	7.70	40	0.040	0.500	0.030	0.117

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/03/14	16 00	0000	0.035	6.8
	16 00	0004	0.034	
	16 00	0007	0.048	
73/09/05	14 55	0000	0.022	11.9
73/11/05	12 45	0000	0.041	7.5
	12 45	0006	0.146	

125

APPENDIX E

TRIBUTARY DATA

STORET RETRIEVAL DATE 75/08/25

1229A1
28 37 30.0 081 21 30.0
UNNAMED TRIB
12105 7.5 CASSELBERRY
O/LAKE MINNEHAHA
HORATIO AVE BRDG IN MAITLAND
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/03/17	14 05		0.010K	0.660	0.025	0.007	0.035
73/04/07	11 40		0.030	1.570	0.075	0.011	0.055
73/05/13	10 45		0.010K	0.630	0.035	0.009	0.050
73/06/17	09 45		0.021	0.700	0.072	0.021	0.030
73/07/07	10 40		0.040	0.720	0.035	0.008	0.040
73/08/04	10 30		0.024	0.690	0.110	0.013	0.025
73/09/08	13 45		0.017	0.940	0.110	0.021	0.040
73/11/03	14 20		0.038		0.082	0.066	
73/12/08	09 30		0.096	0.600	0.072	0.020	0.055
73/12/15	09 15		0.068	0.600	0.064	0.020	0.035
74/01/12	10 30		0.028	0.600	0.032	0.010	0.035
74/02/15	14 10		0.008	1.100	0.010	0.005K	0.035

STORET RETRIEVAL DATE 75/08/25

122981
28 38 00.0 081 21 00.0
UNNAMED TRIB
12 7.5 CASSELBERRY
I/LAKE MINNEHAHA
FROM LGT DUTY RD ALONG STREAM
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/03/17	14	20	0.096	0.480	0.048	0.028	0.045
73/04/07	11	35	0.092	1.890	0.200	0.019	0.030
73/05/13	10	40	0.095	0.270	0.025	0.018	0.030
73/06/17	09	40	0.048	0.460	0.033	0.022	0.025
73/07/07	10	15	0.064	0.600	0.110	0.017	0.035
73/08/04	11	00	0.038	0.580	0.070	0.015	0.035
73/09/08	14	00	0.063	0.770	0.060	0.021	0.035
73/11/03	14	15	0.132	0.700	0.100	0.084	0.115
73/12/08	09	35	0.224	0.600	0.036	0.088	0.145
73/12/15	09	20	0.208	1.100	0.036	0.080	0.120
74/01/12	10	30	0.224	0.700	0.032	0.032	0.065
74/02/15	14	50	0.004	1.500	0.010	0.005K	0.030